Claims

1.   A lithographic apparatus comprising:

an illuminator configured to provide a beam of radiation;

a support structure configured to hold a patterning device, the patterning device configured to pattern the beam according to a desired pattern;

a substrate table configured to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

an aperture configured to permit propagation of the beam of radiation therethrough;

a detector configured to detect an intensity of at least part of the beam of radiation propagating through the aperture; and

a processor configured to vary the intensity of the radiation beam through the aperture by a relative movement of the radiation beam and the aperture and to calculate a beam size of the radiation beam from the detected intensity and relative movement.

2.   A lithographic apparatus according to claim 1, wherein the processor is configured to receive a first relative intensity at a first relative position of the radiation beam and a second relative intensity at a second relative position of the radiation beam and to calculate the beam size as a ratio of differences of first and second relative positions and first and second relative intensities.

3.   A lithographic apparatus according to claim 2, wherein the first and second relative positions correspond to 10% and 90% of the maximum relative intensity of the radiation beam.

4.   A lithographic apparatus according to claim 1, comprising a device configured to change a position of the radiation beam.

5.   A lithographic apparatus according to claim 4, wherein the device comprises a tiltable mirror and the processor is configured to calculate the relative movement of the

radiation beam as a function of a tilt angle of the mirror and as a function of a beam delivery length between the mirror and the aperture.

6.　　A lithographic apparatus according to claim 5, wherein the processor is configured to receive a third relative intensity at a third relative position of the radiation beam at which the radiation beam at least partially overlaps the aperture on a first side of the aperture and to receive a fourth relative intensity at a fourth relative position of the radiation beam at which the radiation beam at least partially overlaps the aperture on a second side of the aperture opposite the first side, the processor further configured to calculate the beam delivery length as a function of tilt angles corresponding to the third and fourth relative positions of the radiation beam and a distance between the opposite sides of the aperture.

7.　　A lithographic apparatus according to claim 5, wherein the mirror is tiltable in two different directions.

8.　　A lithographic apparatus according to claim 5, wherein the mirror is a steering mirror located at a relatively large distance from the aperture.

9.　　A lithographic apparatus according to claim 1, wherein the aperture is formed by edges of a frame of a diffractive optical element.

10.　　A lithographic apparatus according to claim 1, comprising an optical element configured to vary the beam size of the radiation beam, the optical element being coupled to the processor.

11.　　A lithographic apparatus according to claim 1, comprising:
　　　　a focusing element configured to focus a part of the radiation beam in a focus plane;
　　　　an aperture arranged in the focus plane of the focusing element;
　　　　a detector configured to detect an intensity of the part of the radiation beam through the aperture; and

a processor configured to vary the intensity of the radiation beam through the aperture by a change in a pointing direction of the radiation beam and to calculate a beam divergence of the radiation beam from the detected intensity and pointing direction.

12. A lithographic apparatus according to claim 11, comprising:

a first device configured to change a position of the radiation beam to effect the relative movement of the radiation beam and the aperture; and

a second device configured to change the pointing direction of the radiation beam, the second device being provided after the first device in an optical path of the radiation beam.

13. A lithographic apparatus comprising:

an illuminator configured to provide a beam of radiation;

a support structure configured to hold a patterning device, the patterning device configured to pattern the beam according to a desired pattern;

a substrate table configured to hold a substrate;

a projection system configured to project the patterned beam onto a target portion of the substrate;

a focusing element configured to focus a part of the radiation beam in a focus plane;

an aperture arranged in the focus plane of the focusing element;

a detector configured to detect an intensity of the part of the radiation beam propagating through the aperture; and

a processor configured to vary the intensity of the radiation beam through the aperture by a change in a pointing direction of the radiation beam and to calculate a beam divergence of the radiation beam from the detected intensity and pointing direction.

14. A lithographic apparatus according to claim 13, comprising a device configured to change the pointing direction of the radiation beam.

15.   A lithographic apparatus according to claim 14, wherein the device comprises a mirror tiltable in two different directions and configured to change the pointing direction of the radiation beam by tilting the mirror.

16.   A lithographic apparatus according to claim 13, wherein the detector comprises one of an energy sensor and a positional detector.

17.   A lithographic apparatus according to claim 13, comprising:

an aperture;

a detector configured to detect an intensity of at least part of the radiation beam directed through the aperture; and

a processor configured to vary the intensity of the radiation beam through the aperture by a relative movement of the radiation beam and the aperture and to calculate a beam size of the radiation beam from the detected intensity and relative movement.

18.   A lithographic apparatus according to claim 17, comprising:

a first device configured to change a position of the radiation beam to effect the relative movement of the radiation beam and the aperture; and

a second device configured to change the pointing direction of the radiation beam, the second device being provided after the first device in an optical path of the radiation beam.

19.   A method of determining a beam size of a radiation beam in a lithographic apparatus, the method comprising:

changing a position of the radiation beam relative to an aperture through which the radiation beam propagates;

detecting the intensity of at least part of the radiation beam propagating through the aperture relative to a maximum intensity as a function of relative movement of the radiation beam; and

calculating the beam size of the radiation beam from the detected intensity as a function of the relative movement.

20.   The method according to claim 19, wherein calculating the beam size comprises:

detecting a first relative intensity at a first relative position of the radiation beam;

detecting a second relative intensity at a second relative position of the radiation beam; and

calculating the beam size as a ratio of differences of first and second relative positions and first and second relative intensities.

21.   The method according to claim 20, wherein the first and second relative positions correspond to 10% and 90% of the maximum relative intensity of the radiation beam.

22.   The method according to claim 19, further comprising:

reflecting the radiation beam from a mirror;

changing a position of the radiation beam at the aperture by tilting the mirror; and

calculating the relative movement of the radiation beam as a function of a tilt angle of the mirror and as a function of a beam delivery length between the mirror and the aperture.

23.   The method according to claim 22, wherein the mirror is configured to tilt in two different directions and the beam size is measured in the two different directions.

24.   The method according to claim 22, wherein the mirror is a steering mirror located at a relatively large distance from the aperture.

25.   The method according to claim 22, further comprising:

detecting a third relative intensity at a third relative position of the radiation beam at which the radiation beam at least partially overlaps the aperture on a first side;

detecting a fourth relative intensity at a fourth relative position of the radiation at which the radiation beam at least partially overlaps the aperture on a second side opposite the first side; and

calculating the beam delivery length from tilt angles corresponding to the third and fourth relative positions and from a distance between the opposite sides of the aperture.

26.   The method according to claim 25, wherein the third and fourth relative positions of the radiation beam correspond to 50% of the maximum relative intensity through the aperture.

27.   The method according to claim 19, comprising varying the beam size of the radiation beam so as to tune the radiation beam to a desired beam size.

28.   A method of determining a beam divergence of a radiation beam in a lithographic apparatus, the method comprising:

focusing a part of the radiation beam in a focus plane, an aperture being provided in the focus plane;

changing a pointing direction of the radiation beam;

detecting the intensity of the part of the radiation beam propagating through the aperture relative to a maximum intensity as a function of the pointing direction of the radiation beam; and

calculating the beam divergence of the radiation beam from the detected intensity as a function of the pointing direction.

29.   The method according to claim 28, wherein calculating the beam divergence comprises:

determining a first relative intensity at a first pointing direction of the radiation beam;

determining a second relative intensity at a second pointing direction of the radiation beam; and

calculating the beam divergence as a ratio of differences of first and second pointing directions and first and second relative intensities.

30.   The method according to claim 28, wherein the intensity is detected using one of an energy sensor and a positional detector.

31.   The method according to claim 28, wherein the pointing direction of the radiation beam is changed by reflecting the radiation beam on a mirror and tilting the mirror in two different directions so as to change the pointing direction of the radiation beam.